Scientific Computation Advances Two Giant Steps

EAI

8400

SCIENTIFIC COMPUTING SYSTEM

The Fastest Floating Point Digital Computer Available

The EAI 8400 Scientific Computing System is the first major digital computer specifically designed to satisfy the requirements of fast real-time applications—in digital and hybrid simulation or on-line monitoring and control—and the requirements of general purpose scientific computing. It offers more computing throughput per dollar than any other medium-scale digital computer presently available. Highlighted among the features are high-speed arithmetic, a 32-bit memory word, the most powerful and versatile instruction repertoire in the industry, in-field expansibility and unparalleled facilities for cutting down the extensive time normally required for program set-up and checkout (which can be 60% of the total program time). The 8400 was created and is produced by EAI—a firm acknowledged as a leader in scientific computing for the past 15 years . . . a guarantee of continuing, competent service support and improvements in advance of the state-of-the-art.

8800

SCIENTIFIC COMPUTING SYSTEM

A ±100 Volt Solid-State ANALOG/HYBRID COMPUTER.

The use of analog **and** digital computing elements in an integrated system provides an entirely new approach to simulation. State-of-the-art performance of this integrated analog and digital equipment enables solution of a wider range of more sophisticated problems at a lower cost per solution. Evolving from the EAI PACE and HYDAC computers, yet including entirely new basic circuitry and system design, the EAI 8800 combines patch-board-programmed analog and digital logic computing elements with a stored-program digital computer input-output system—specifically designed as an integral part of the system. Entirely new input-output and other peripheral equipment is available for use with the EAI 8800—providing maximum man-machine communication and expanding the utility of advanced computing techniques for more engineers and scientists. By system-engineering the EAI 8800 for use with the new, powerful EAI 8400 digital computing system, scientific computing facilities are provided with the capability for ready expansion to a complete hybrid computing installation.

EAI 8400

SCIENTIFIC COMPUTING SYSTEM

TECHNICAL SUMMARY

32-bit word—balanced for floating point precision, storage efficiency, and maximum instruction power.

Powerful instruction repertoire—designed to reduce the number of instructions per program—lowering programming time, running time and storage requirements.

Ultra-high-speed multiple precision floating and fixed point arithmetic. (FLT MPY: 5.5 - 7.5 usec) (FLT DIV: 8.75 - 10 usec) (FIX MPY: 4.5 - 6.5 usec).

Flexible data handling capability with complete set of I/O and Boolean instruction for 16, 8, 4, 2, and 1-bit byte manipulations.

2 usec memory—from 4096 to 65,536 words—with direct, multi-level indirect, immediate and byte addressing; 7 index registers and optional fast memory.

Simultaneous communications with external devices through data channels designed for the new standard Interchange and existing codes.

Unique EXEC bit control for dynamic relocation and memory protect; autonomous modular organization for multi-processor and multi-user requirements.

Programming systems including FORTRAN IV, Symbolic MACRO Assembler, Real-Time Monitor and special software for digital and hybrid simulations.

EAI 8800

SCIENTIFIC COMPUTING SYSTEM

TECHNICAL SUMMARY

High-performance ±100 volt all solid-state operational amplifier offers un-matched stability and frequency response.

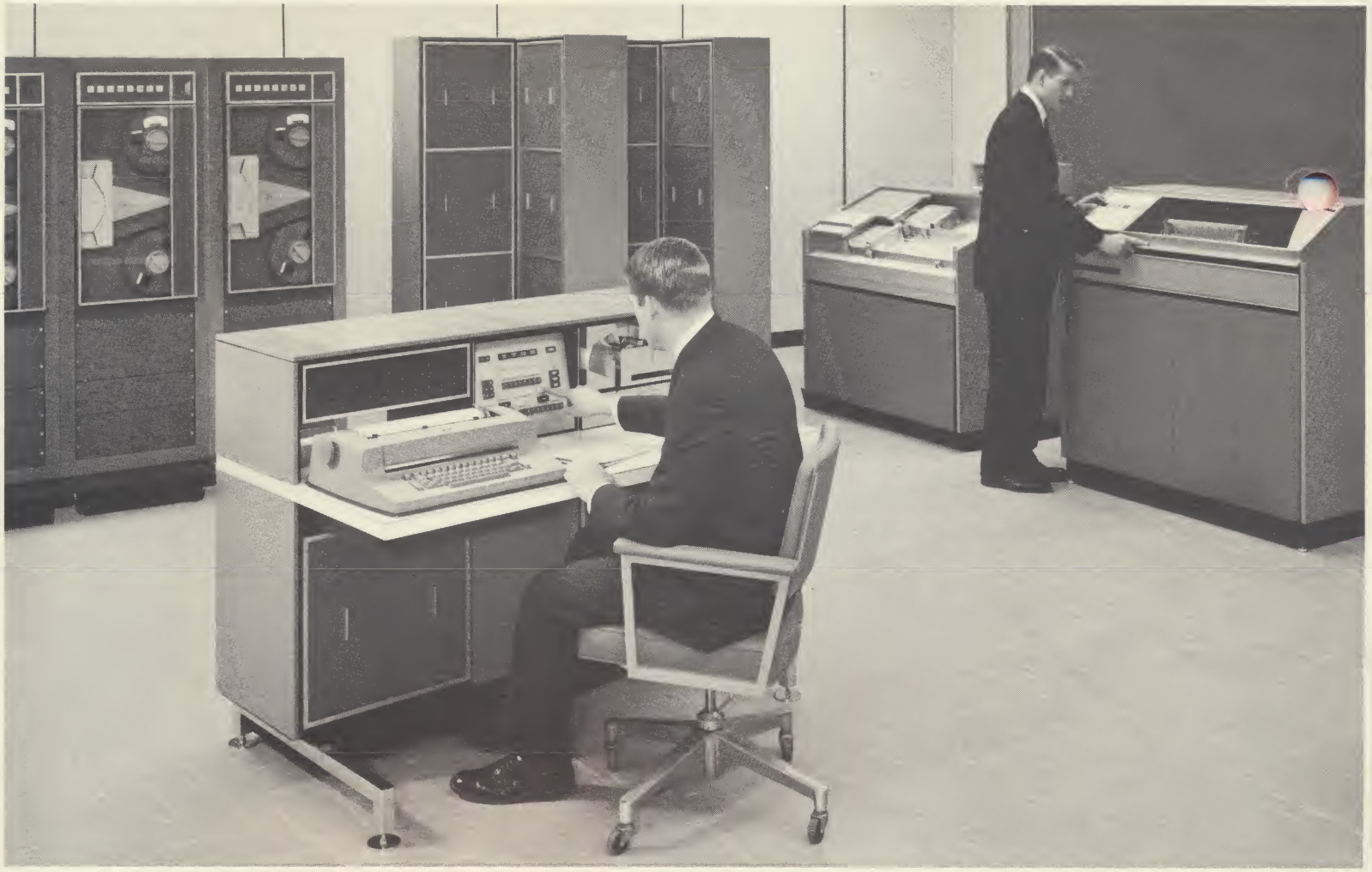
Wide-bandwidth computing components significantly extend usable computing frequencies.

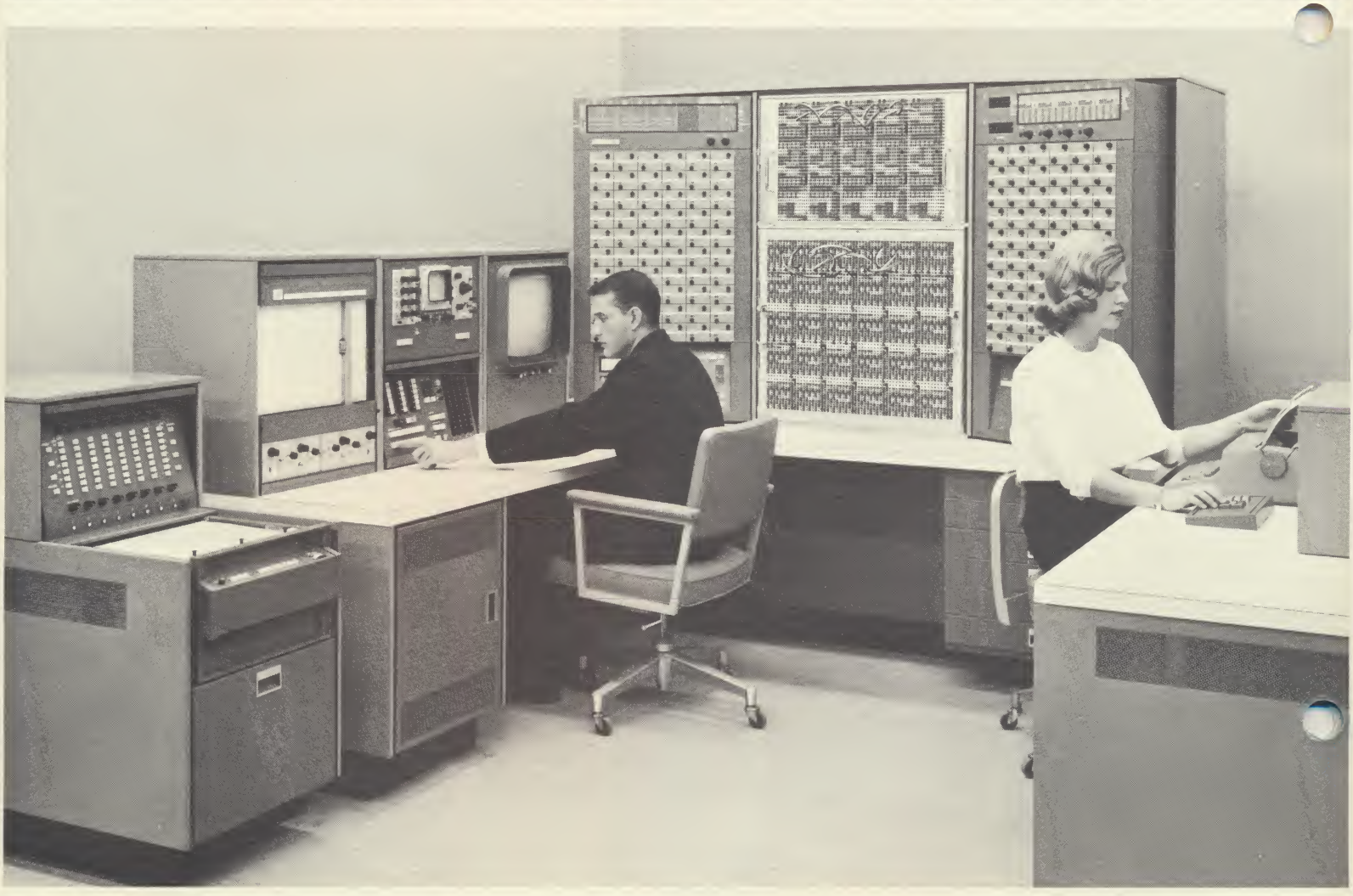
Extensive digital logic capability permits simulation of discrete and continuous systems.

High-speed analog/digital interface simplifies expansion to large-scale hybrid system.

Stored-program digital input-output system makes possible automatic operation and re-programming.

High-accuracy display and readout equipment establishes maximum man-machine communication.





8400

Machine Concepts

The EAI 8400 is two computers in one. It combines ultra-fast program execution with an extensive instruction repertoire—including full floating and fixed-point arithmetic, as well as the capability for handling a complete set of byte manipulating connectives.

A new structural organization integrates autonomous Processor, Memory, Exchange and Access Device systems into configurations ranging from basic to high capacity single and multi-processor systems. In-field expansion of each of these four elements can be accomplished as the user's computational demands increase—without obsoleting 8400 hardware or programs.

Floating Point Processor

The 8400's Processor provides high-resolution floating-point speeds **which exceed the fixed point speeds of most other computers**—offering real-time floating point capabilities for the first time. The floating point system is capable of 32-bit single precision arithmetic, 56-bit double precision arithmetic and integer arithmetics; each class includes 10 instructions. The Integer class enables mixed operations with 32-bit floating point operands and 16-bit fixed point operands or address fields.

Other Processor features include: a full set of 16 logical connective commands for performing byte operations; universal accumulator for programming simplicity; Save Register for fast temporary storage; basic complement of 7 index registers; masked priority interrupt system and register overflow control. Expansion options include a 16-word Rapid Access Field for high-speed looping or scratchpad memory programming techniques, and an Interval Timer for real-time clock control.

8800

Maximum Program Flexibility

Programming and checkout times are dramatically reduced by the EAI 8800 through use of the Input-Output System—which includes a stored-program digital computer with a 4000-word memory capacity, and high-speed punched tape and typewriter input-output. In addition to adjustment of coefficient attenuators and overall control of the computing system, programs are available for performing automatic re-scaling, static check calculations, and automatic re-calculation of attenuator settings. The high-speed input-output system also makes it possible to scan and print-out component outputs at speeds not previously possible with any analog computer. Automatic comparison of measured outputs vs. calculated values makes it possible to rapidly locate faulty components or necessary program changes for subsequent correction.

Mode control and time scaling provisions included in the EAI 8800 allow the programmer individual control of each element in the computing system. The machine time-scale selection system permits overall change of the time scaling for both analog and digital computing elements. The use of general-purpose logic elements synchronized with a system clock allows the programmer to perform step-by-step checkout of mode control sequencing. These and many other attractive features give the EAI 8800 more flexible program control than previously obtainable.

Separate analog computer and control logic patching systems are used with the EAI 8800 for ease of programming. The clearly labeled, color-coded patch panels are arranged to employ a co-ordinate address system for the tracing and location of components. Special provisions are included to prevent damage to digital logic elements through improper patching of high voltage signals. A unique patch bay switch performs multiple programming functions with the insertion of a single patch cord.

Memory

The 8400's memory has been designed for maximum storage efficiency and accessing speed. With each memory location containing 32 bits for data or instruction storage (plus 2 EXEC bits for control and dynamic relocation and 2 parity bits), 32-bit floating point operands can be stored in a single location—and accessed in a single cycle. The ability to pack two half-words in a memory location effectively doubles the storage capacity available for 16 bit data and address field. In addition, byte manipulating capabilities of the 8400 Processor permit cycle one transfer and storage of 16, 8, 4, 2 and 1 bit bytes. All storage locations can be selectively protected against accidental overwrite.

A maximum directly addressable memory capacity of 65,536 storage locations may be structured by modular expansion with independent memory banks. These banks, available with 4096, 8192 and 16,384 word capacities, have access times of 1 microsecond and cycle times of 2 microseconds. Each has its own read/write control and is capable of being addressed separately and/or simultaneously with other banks. This autonomy feature enables overlapped memory operation as well as simultaneous Processor and peripheral device access to separate memory banks.

Exchange Module

The highly versatile 8400 Exchange Module contains a general purpose data channel control system for data exchange between Memory or Processor and external devices, plus a flexible Systems Interface that facilitates integration of the 8400 into special systems.

The channel control system provides internal communications paths and program control for up to eight bi-directional buffered Data Channels, each with provision for parallel connection of 15 peripheral devices. Forward looking design, incorporating full capabilities for handling both the new Standard Interchange and existing codes, assures compatibility with new devices. For the user with high-speed block data transfer requirements, an optional Automatic Data Channel Control System enables this type of operation to proceed concurrently with computation.

The Systems Interface of the 8400 is designed to accommodate a large number of Status and Function control lines and up to 256 external priority interrupt lines, as well as external system connections to an Addressable Input Buss and an Addressable Output Buss.

Unexcelled Computer Performance

To satisfy complex simulation requirements, emphasis has been placed on the performance of the overall system as well as that of the individual computing components. Improved static and dynamic performance offers significant advancements over computing equipment previously available to the simulation laboratory. High speed operation is made possible by a unique mechanical and electrical construction—which locates the operational amplifiers directly behind the patch bay of the computer, thus minimizing crosstalk. Components are packaged in individual metal trays for maximum shielding, and employ a power distribution system to eliminate coupling through the power supplies. All components are compensated for maximum dynamic characteristics, and are matched to the performance of the operational amplifier. All solid-state mode control switching, combined with a selection of time scales for all time dependent components in the system, facilitate high-speed repetitive and iterative techniques for the solution of partial differential equations and adaptive or predictive computing programs.

To assure maximum static and dynamic accuracies, particular emphasis has been placed on controlling the environment in which the computing components must operate. Heat producing power supplies are contained in a separate power module to eliminate drift and other harmful effects of temperature. An integral air conditioning unit permits stringent control over the temperature of all elements in the computing system, and makes it possible to take full advantage of the exceptional stability and drift characteristics of the operational amplifier.

Extended Input/Output Capability

Since the usefulness of any electronic computer is determined to a large extent by its ability to communicate with the operator or programmer, man-machine communication was of prime importance in the design of the EAI 8800. Entirely new peripheral equipment has been designed into the 8800 system to provide operator communications compatible with superior operational performance. Among these are the digital input-output computer, a new all-solid-state computer recorder, a high-speed cathode-ray tube display unit, and a high-speed line printer.

The Input-Output System features a small stored-program digital computer with high-speed punched tape input-output and a 4000-word memory capacity. Software programs make possible automatic rescaling of programs, static check calculations, and completely automatic control of computer operations.

Access Devices

The 8400 Console Desk contains complete display, control and maintenance facilities for monitoring and manual control of all elements in the system. It includes an on-line typewriter for manual and program control input and output, and direct man/machine communication via a special set of register controls—enabling on-line changing of problem parameters by the operator.

Optional Access Devices, covering a wide range of transfer rates, include: CRT display monitor, magnetic tape units at 30, 45 and 75 ips and all three bit densities, high and low-speed line printers, card readers and card punches, a graphical plotter and a paper tape station.

Programming System

EAI provides comprehensive programming systems for all Series 8000 digital computers. These include: SYMBOLIC MACRO ASSEMBLER and one-pass FORTRAN IV COMPILER 84—for real-time programs such as execution time accumulation and delay loop generation; SIMULATION MONITOR 84 for function generation, integration and mode control for digital and hybrid simulation; HYTRAN 84—an exclusive EAI program for analog and hybrid computer problem preparation, set-up and checkout; RELOCATABLE LOADER 84, DEBUG SYSTEM 84 and SUBROUTINE LIBRARY.

The EAI 8400 Scientific Computing System was designed to meet two important criteria . . . economical high speed processing and ease of programming. The successful implementation of these goals enables the user to achieve maximum computing throughput per dollar—thus fulfilling the basic reasons for any investment in computing equipment.

The all-solid-state computer recorder, specifically designed for use with the EAI 8800, provides forced fluid rectilinear presentation of up to eight analog and two event channels. Inputs to the event channels and selection of chart speed is under program control.

A unique, high-speed cathode-ray tube display unit provides extraordinary resolution and accuracy in the display of high-speed computer solutions. Up to eight input channels may be displayed simultaneously with individual trace identification coding. Time base selection as well as complete scale factor and parallax control allows the operator to examine specific areas of the problem solution.

In order to take full advantage of the readout capability of the EAI 8800, a high-speed line printer provides a complete print-out of all analog outputs in less than a minute.

The 8800 Scientific Computing System, then, provides EASIER SIMULATION—enabling the use of advanced techniques by more scientists and engineers; MORE EFFICIENT SIMULATION—cutting time and costs in programming, checking, and operation; MORE POWERFUL SIMULATION—by expanding the spectrum of problems that can be undertaken by a simulation facility. The 8800 is a giant advancement in analog and hybrid simulation.

Products and Services by EAI

Used in complex aerospace installations, in university classrooms and in major industrial and research complexes, EAI computing systems reflect adherence to high standards of product utility, quality and dependability. Customer acknowledgement and acceptance of this philosophy has enabled EAI to become a leading source for all types of scientific computing systems—analog, digital and hybrid.

To complement design and manufacturing excellence, EAI provides a program of COMPLETE CUSTOMER SUPPORT. In selecting, operating or maintaining equipment, in training personnel, in developing new computational techniques, every assistance is provided to the user for maximum utilization of his equipment.

Six EAI Computation Centers provide scientific, engineering and research organizations throughout the world with mathematical analysis, programming capability, and the most advanced scientific computers for the effective solution of the complex problems encountered in modern technology. These same Centers provide education and training for the development and dissemination of new skills—including product and application familiarization for new customer operating and maintenance personnel.

EAI worldwide Service Engineering provides a complete support capability for planning, installation and checkout, contractual preventive maintenance, regional service and parts, factory equipment repair, equipment modernization, rehabilitation and expansion.

Product usefulness, quality, dependability—backed by complete customer support—have established the EAI hallmark throughout the world.

Look to EAI for world-wide leadership in scientific computation

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ADVANCED SYSTEMS ANALYSIS AND COMPUTATION SERVICES/ANALOG COMPUTERS/DIGITAL COMPUTERS/HYBRID ANALOG-DIGITAL COMPUTATION EQUIPMENT/ANALOG AND DIGITAL PLOTTERS/SIMULATION SYSTEMS/SCIENTIFIC AND LABORATORY INSTRUMENTS/INDUSTRIAL PROCESS CONTROL SYSTEMS/PHOTOGRAMMETRIC EQUIPMENT/RANGE INSTRUMENTATION SYSTEMS/TEST AND CHECK-OUT SYSTEMS/MILITARY AND INDUSTRIAL RESEARCH AND DEVELOPMENT SERVICES/FIELD ENGINEERING AND EQUIPMENT MAINTENANCE SERVICES.

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FOR IMMEDIATE RELEASE

NEW AMBILOG 200 CENTRAL PROCESSOR

BOSTON--Adage, Inc. announces a new series of lower-cost central processors for its Ambilog 200 general purpose hybrid computer product line. The new central processors are reduced in price up to 40% from their predecessors. Processor prices now start at $45,000 for a configuration including 4,096 words of 30-bit core memory, a system controller, an arithmetic unit, five channels of priority interrupt, and Teletype input/output. The high degree of modularity of the Ambilog 200 system allows for larger configurations ranging in price upwards to $500,000 according to an Adage spokesman. These expandable Ambilog 200 systems consist of hybrid arithmetic arrays, a full line of digital I/O peripherals, and various central processor options, including up to 32K words of core memory, additional priority interrupt channels, and an extended arithmetic unit.

The new central processor is being shown for the first time at the Spring Joint Computer Conference being held in Atlantic City starting April 18, 1967. A three-part demonstration program will illustrate the general purpose nature of the Ambilog 200 system.

Part I is a demonstration of on-line editing, compiling, and running of FORTRAN programs, with results plotted on the system display scope. It illustrates the high degree of user interaction provided by the software operating system and oscilloscope for source language text editing and for viewing computed results in graphical form.

Part II highlights the use of Ambilog 200 for on-line signal analysis. A digital recording of a heartbeat signal is circulated in a buffer and under light pen control subjected to various mathematical transformations, with immediate display of the results. The same general-purpose signal analysis program can also be used to analyze and compress speech, and for a host of other similar tasks.

Part III demonstrates the unusual power of the Ambilog 200 for two-dimensional and three-dimensional computer graphics. The computer is used to present arbitrary projections of three-dimensional images, with no speed penalty for frame-to-frame changes in the image or display parameters. For example, a space capsule orbiting the earth is displayed, with on-line joystick attitude control. A joystick is also used to control the position of the viewing window represented by the display scope and for scaling the object viewed. Keyboard type-ins allow changes in orbital trajectory and speed of earth movement.

To perform this real-time coordinate transformation and display generation on unchanging object coordinate lists in memory, the Ambilog 200 uses a parallel hybrid array which operates with an effective multiply-and-add rate in excess of one million per second.

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